Revival of an Electro-Magnetic Resonance (EMR) Machine

A thesis submitted in partial fulfillment of the requirements for the degree

of

Bachelor of Technology

in

Mechanical Engineering

by

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Rourkela-769008, Orissa, India

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Under the guidance of

Prof. Prabal Kumar Ray

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CERTIFICATE

This is to certify that the thesis entitled, "**Revival of An Electro-Magnetic Resonance (EMR) machine** "submitted by **Sanjay Chauhan** in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology** during session **2009-10** in **Mechanical Engineering** at the **National Institute of Technology, Rourkela** is an authentic work carried out by him under my supervision and guidance.

And to the best of my knowledge, the matter embodied in the thesis has not been submitted to any other University/Institute for the award of any Degree or Diploma.

PLACE: NIT Rourkela
DATE: 08/05/2010

Prof. Prabal Kumar Ray
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ACKNOWLEDGEMENT

I wish to express my deep sense of gratitude and indebtedness to **Prof. Prabal Kumar Ray** Department of Mechanical Engineering, **N.I.T. Rourkela** for introducing the present topic and for his inspiring guidance, valuable suggestions and support throughout this project work. And also I am thankful to **Prof. Sandip Ghosh** of Electrical Department who made me understand the Electrical prospects of the project.

I am thankful to **Prof. K.P.Maity** for encouraging us for the Project work and all my Professors and members of the department for their generous help in various ways for the completion of the thesis work.

I would like to thank my family members for encouraging me at every stage of this project work. Last but not least, my sincere thanks to all my friends who have patiently extended all sorts of help for accomplishing this undertaking and T.M. Ladwa who rubbed the shoulders with me until completion of the project. .

Sanjay Chauhan

Abstract

The EMR (Electro Magnetic Resonance) Machine has been designed for high cycle fatigue testing of materials (mainly metals). The EMR machine frame comprises two masses separated by a stiff spring. The 'spring' consists of the specimen being tested, its gripping attachments and load cell. The spring/mass system is supported and guided by leaf springs. Each mass is attached to four leaf springs; the upper mass is attached to its support springs through two long columns. The two sets of support springs are separated by four Acme screws which pull together or push apart the nodal points of the upper and lower mass springs are to apply a compressive or tensile mean load when rotated by a servo motor through worm gears. The nodal points of the upper and lower mass springs are rigidly held to a cruciform and the use of two contra – oscillating masses eliminates the need for a heavy and cumbersome seismic block. Here our work is to restore the Electro Magnetic Resonance machine, as due to some electrical circuit fault and further many breakages the machine stopped working at all. So in final year this project"Revival of the EMR machine "is allotted as interdisciplinary project work for Mechanical Engineering and Electrical Engineering.

Chapter 1

1.1 Machine Introduction

The resonant system of Model 1603 differs from any previous EMR machine in that it employs two masses separated by the specimen. In all other machines one end of the specimen is attached to a large reaction or seismic mass and the other end to the operating or vibrating mass. In the EMR, the two masses are contra-oscillating. The complete resonant system is as shown below:

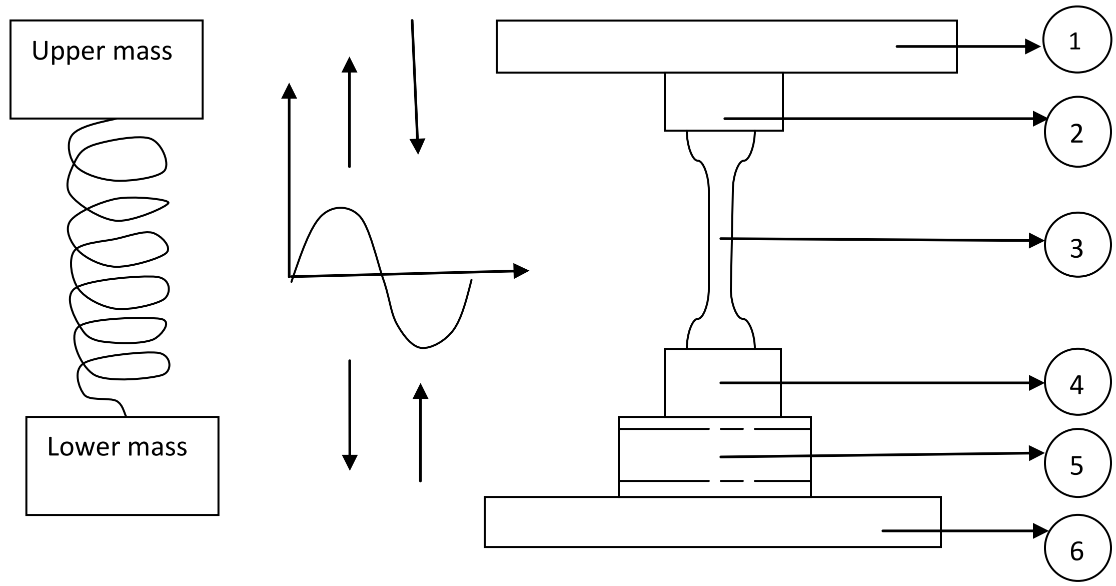


Figure 1: Basis of EMR Machine (Reference No.-1)

Where: (1) ⟶ Upper mass

(2) ⟶ Upper grip

(3) ⟶ Specimen

(4) ⟶ Lower grip

(5) ⟶ Load Cell

(6) ⟶ Lower mass

If the system is excited, say by a hammer blow, it will resonate at a frequency determined by the masses and the combined spring rate of specimen, grips and load cell. Unless the hammer blow is repeated continuously the resonance will decay at a rate determined by the system losses or damping. Losses occur due to internal friction within the materials of the specimen and other components, to friction at joints between the components and to the masses moving through the air .The support / mean load springs are designed to have much more deflection than any specimen, they therefore have virtually no affect on the resonance of the system. Each of the four springs consists of a pair of leaf springs. Two springs of a pair are separated vertically and that each pair is one side of a square. This produces a stable frame without the need for sliding alignment devices. Manual mean load is applied and daylight adjusted by the central screw in the upper mass. The mean load, either tensile or compressive, is carried by the support springs. The screw is positioned by a rotating nut and worm drive by a removable handle. The air gap between the electro-magnet and its armature limits the movement of the lower mass and hence the maximum deflection in the specimen. Due to electro-magnet losses the air gap can not be made too large. To overcome this simple servo system is used to command by the LVDT signal positions a wedge beneath the electro- magnet to increase or decrease the gap. The desired gap is simply set on a control mechanically coupled to the LVDT.To initiate resonance a pulse is applied to the magnet when the start button on the console is depressed. The resultant resonant frequency signal from the load cell is used to generate pulses to drive the electro- magnet and so maintain resonance. The resonant load amplitude is controlled by a servo loop varying the width and phase of the pulses to the electro- magnet from a command signal set at the console front panel [1].

EMR machine schematic diagram:

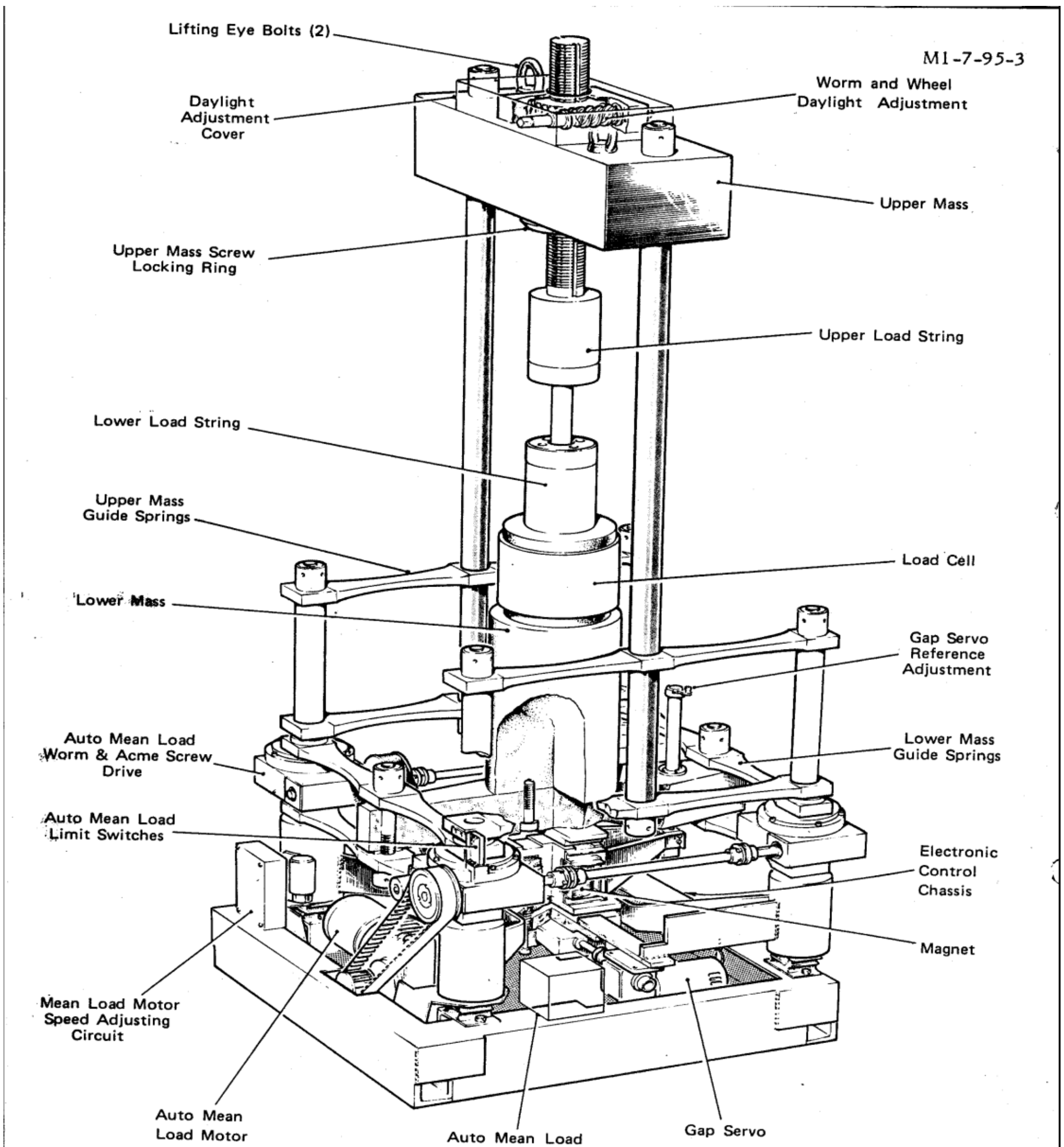


Figure 3.1 Components of Auto Mean Load Resonant Frame

3-4

Figure 2: Exploded view of an EMR machine (Reference No. -1)

1.2 Motivation

1. EMR (Electro magnetic resonance) machine was imported from England to NIT Rourkela in 1988, after years of operation this machine was lying nonoperational from past 3 years.

2. Presently servo-hydraulic fatigue test machine **is** in use for fatigue testing and the principle of operation is hydraulic based due to which the cyclic loading which can be applied is limited to 6Hz where as this Electromagnetic based machine which can be tested till 150 Hz cyclic loading.

3. These testing machines are highly expensive and a nonoperational machine is worth nothing and one day it could have been sold to some scrap vendor in very low cost as the rate of steel.

This motivated us to take up this hilarious task in collaboration with Electrical Engineering department as final year B.Tech project work with an objective to restore the machine to some use at least for Tensile/Compressive test, and develop indigenous skills in this respect.

1.3 Objectives

1. To make the existing old EMR machine operational.

2. To achieve 1 the following sub objectives are planned

- (i) To understand the basic working principle of the fatigue Testing machine
- (ii) To dismantle the machine by opening different parts and draw the mechanical transmission system.
- (iii) To construct the connection diagram of the machine with respect to different motors, power circuit and other components.
- (iv) To understand the functionality of individual mechanical parts.

3. To understand mechanism of each and every parts which communicate mechanically to each other.

4. To reassemble the machine and connect the individual components together.

5. Testing of the machine for confirmation of its working.

1.4 Approach

1. We had a meeting with the project guides to understand the objective of the project. (Aug, 2009)

2. After we saw the machine and the circuits, it was noticed that the condition of the circuits were very bad. The rats in the room had cut the wires between the components and made it difficult to guess which wire will be connected to which electronic component. (Aug 2009)

4. The manual which was provided with machine had only information about the usage and features of the machine, there was hardly any information about the circuits or their diagrams, so we had to wait to interact with the service engineer who was about to visit for other fatigue test machines which were under service contract. It was understood from the engineer that the circuit diagrams of the machine no more exists because the company has stopped manufacturing and service to this machine. It was learned that there were few machines left in India one of which could be found in NIT Jamshedpur. (Sep, 2009)

6. The machine was dismantled by carefully feruling the connected wires (Oct, 2009)

7. The individual circuits were identified as control circuit, protection circuit and magnet controller and the Electronic cards were drawn on paper. (Oct - Nov, 2009; Jan, 2010)

8. The connection diagram was constructed by thoroughly examining the machine (Nov, 2009)

9. The faults where identified in magnet controller and fixed, the faults were mainly open circuit. The faults in the protection circuit were identified and fixed. There were too many open circuits in control circuit which jumbled us to fix it (Jan-Feb, 2010)

10. In a meeting between Prof Prabal Kumar Ray and the guides it was decided that it will be difficult for us to fix the machine without the complete knowledge of the controller and also at some point it was decided that to proceed for designing and implementing new controller circuit and protection circuit but that would require years of rigorous research. Prof Prabal Kumar Ray suggested to make the machine workable for at least for tensile and compression testing even if fatigue testing is compromised for some time (March, 2010).

11. The DC supply to test the motor was made and the DC motor was tested which paid the way to start the machine. It was observed that the job could be given tensile and compression loading through downward and upward displacement of load cell. (March 2010)

Chapter 2

2.1 EMR Machine working principle

A cyclic load is produced in the specimen by exciting the natural resonance of a mass supported by a spring. The specimen is the spring and the mass is incorporated in the machine structure. Resonance is maintained by a sympathetically excited electro – magnet, which only has to supply sufficient power to overcome the system damping losses. Mean load can be applied either, tensile or compressive, by springs have a much higher deflection per unit force than the specimen they will have an insignificant effect on resonant properties of the specimen/mass system.

The EMR (Electro Magnetic Resonance) Machine has been designed for high cycle fatigue testing of materials (mainly metals). The model 1603 EMR machine frame comprises two masses separated by a stiff spring. The ‘spring’ consists of the specimen being tested, its gripping attachments and load cell. The spring/mass system is supported and guided by leaf springs. Each mass is attached to four leaf springs; the upper mass is attached to its support springs through two long columns. The two sets of support springs are separated by four Acme screws which pull together or push apart the nodal points of the upper and lower mass springs are to apply a compressive or tensile mean load when rotated by a servo motor through worm gears. The nodal points of the upper and lower mass springs are rigidly held to a cruciform and the use of two contra – oscillating masses eliminates the need for a heavy and cumbersome seismic block. The frame assembly is isolated from the machine base by anti- vibration mounts between the plinth and the cruciform. These mounts ensure that very little vibration is passed through to the floor on which the machine stands. The machine covers are free – standing to avoid contact with the resonance frame. The electro- magnet is fixed to the cruciform and positioned on a servo- driven wedge, enabling the air gap between the armature, attached to the lower mass, and the magnet to be controlled. When the magnet is energized, the air- gap closes applying a tensile load to the specimen. The magnet is energized by high current pulses generated at the natural frequency of the spring/mass assembly so that a resonant system is maintained. A mean load is applied to the specimen by establishing a reference level on a potentiometer labeled ‘M.L.Demand’. A servo motor energized by a comparator amplifier in the base of the test frame drives the four Acme screws between the upper and lower mass support springs, so as to apply the required mean load in tension or compression. During a test the specimen under load will yield and, as a result, the mean load will tend to fall off. The servo, when set for automatic operation, will operate during the test to maintain the demanded load [1].

From figure we can understand the basic principle of machine:

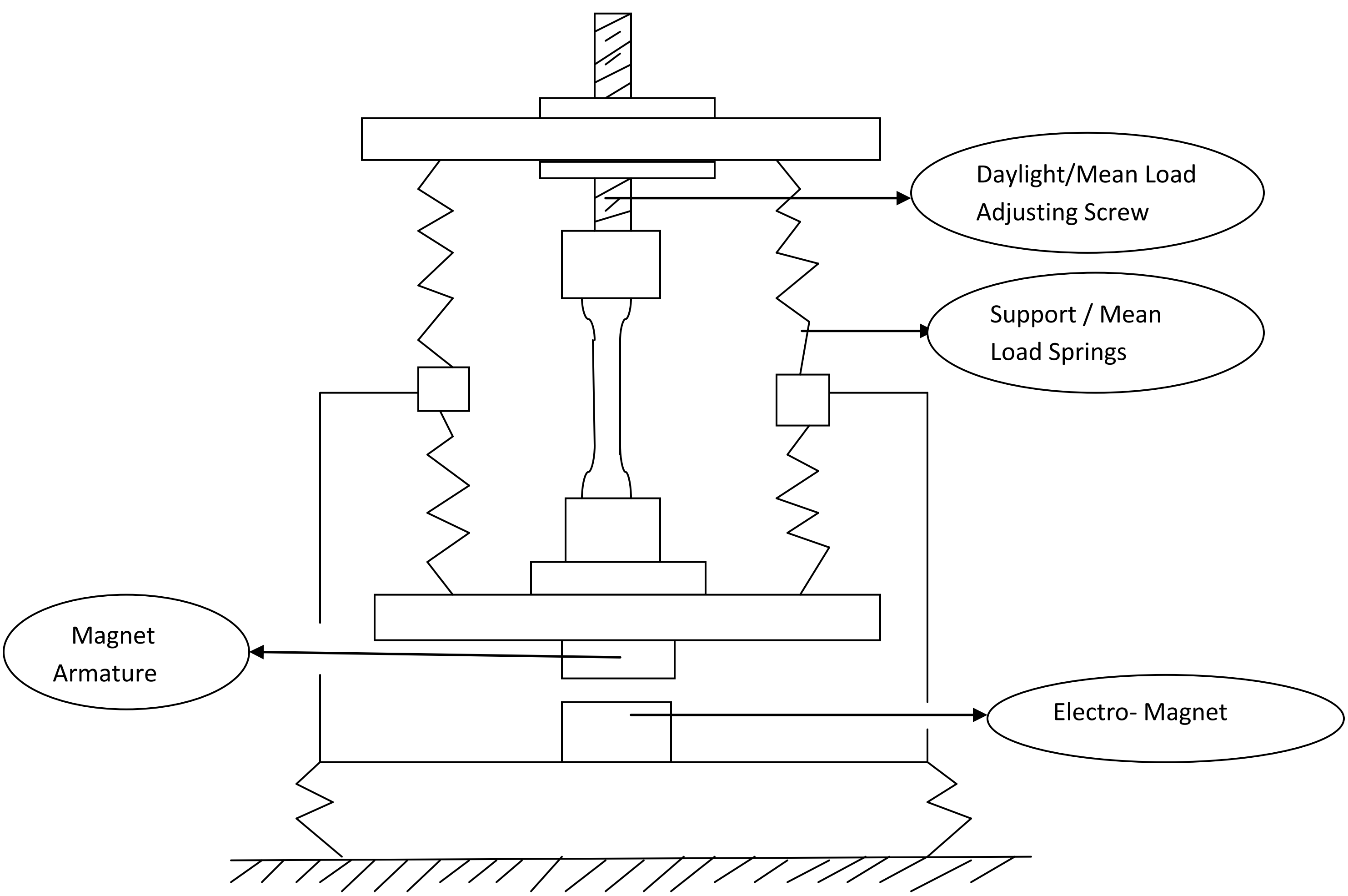
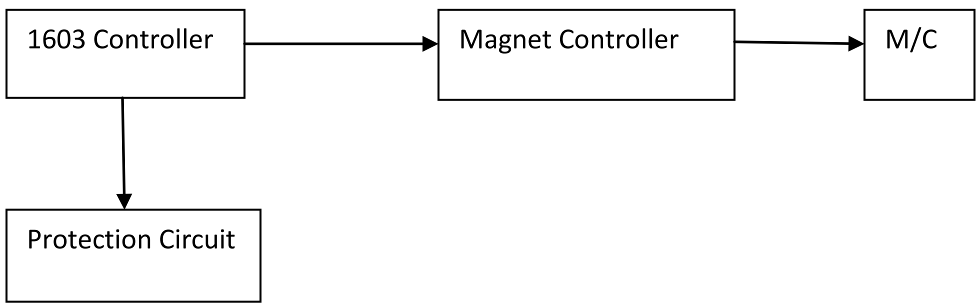


Figure: 3- Mechanical schematic of EMR machine (Reference No.-1)

2.2 Important features of EMR



As above mentioned block diagram indicates that to run the machine for an optimum load condition we have to go in proper way firstly the power has given to 1603 controller and then it goes to magnet controller and finally to machine. Here a protection circuit is communicated with 1603 controller to avoid any problem regarding high voltage and current.

2.3 System description

The model 1603 EMR machine frame comprises two masses separated by a stiff spring. The 'spring' consists of the specimen being tested, its gripping attachments and load cell. The spring/mass system is supported and guided by leaf springs. Each mass is attached to four leaf springs, the upper mass is attached to its support springs through two long columns. The two sets of support springs are separated by four Acme screws which pull together or push apart the nodal points of the upper and lower mass springs are to apply a compressive or tensile mean load when rotated by a servo motor through worm gears. The nodal points of the upper and lower mass springs are rigidly held to a cruciform and the use of two contra – oscillating masses eliminates the need for a heavy and cumbersome seismic block. The frame assembly is isolated from the machine base by anti- vibration mounts between the plinth and the cruciform. These mounts ensure that very little vibration is passed through to the floor on which the machine stands. The machine covers are free – standing to avoid contact with the resonance frame. The electro-magnet is fixed to the cruciform and positioned on a servo- driven wedge, enabling the air gap between the armature, attached to the lower mass, and the magnet to be controlled. When the magnet is energized, the air- gap closes applying a tensile load to the specimen. The magnet is energized by high current pulses generated at the natural frequency of the spring/mass assembly so that a resonant system is maintained. A mean load is applied to the specimen by establishing a reference level on a potentiometer labeled 'M.L.Demand'. A servo motor energized by a comparator amplifier in the base of the test frame drives the four Acme screws between the upper and lower mass support springs, so as to apply the required mean load in tension or compression. During a test the specimen under load will yield and, as a result, the mean load will tend to fall off. The servo, when set for automatic operation, will operate during the test to maintain the demanded load.

The application or change of mean load changes the gap between the faces of the electro- magnet and its armature. An LVDT (Linear Variable Differential Transducer) is mounted across the gap and senses the change. The LVDT output actuates the servo operated wedge to drive in or out to maintain a pre-selected air – gap. The selection of air–gap size is made by the operator based on the predicted specimen excursion for the load being applied. A graduated knob for setting the air-gap is sited on the lower mass. As the specimen, its grips and adaptors are part of the spring / mass system, the characteristics of these components largely dictate the performance of the machine during a test. The specimen can only be tested if it will respond as a spring, i.e. a metal tested within its elastic range. In the model 1603 Machine, the basic spring/ mass is suspended on support springs, an electro- magnet is positioned below the two masses to maintain oscillation at the natural resonant frequency. A position screw enables adjustment of the height of the upper specimen grip and can also, if necessary, apply a mean load by deflection of the support springs. The spring mass is maintained at resonance by magnet drive pulses , generated in a power amplifier , in synchronism with the natural frequency of the resonant system , using the load cell out put as a timing waveform. The design of the power amplifier is novel and is the subject of a patent application. Normally the magnet would be powered by a large linear amplifier of about 1,000 W with a frequency spread of about 50-400 Hz. The power dissipation of such an amplifier results in considerable heat with consequent loss of reliability. The amplifier of the Model 1603 EMR Machine works as a switching device with considerably reduced dissipation and makes a further power reduction by feeding back into the power supply the energy produced by the magnet back e.m.f. This results in a power consumption of only 150 W, approximately, to maintain the full load capabilities of the machine. The mean load is automatically maintained on the specimen by four Acme screws at the corners of the support spring structure. The springs are belt driven from a reversible drive motor through worm gear boxes and the motor is energized in the required direction by a servo system which constantly compares the required mean load with the actual mean load and turns the screws to adjust for the difference. In addition, the speed of rotation of the motor can be adjusted to meet test requirements so that the rising speed under stress is correct [1].

2.4 Introduction to application[1]

Electro-magnetic resonance (EMR) machines are used in high cycle fatigue testing of metals which includes:

- Production of data for S/N curves. Specimens are cycled to failure at different stress amplitudes. A curve is plotted of stress amplitude against number of cycles to failure. A specimen which has not failed at cycles near to 10^7 is assumed to have infinite life.
- Pre-cracking of compact tension and bend specimens for fracture toughness determinations. It is a requirement that a sharp, straight fronted crack is grown from the machined notch. The crack is initiated at one amplitude and then grown to the required length at lower amplitude.
- Crack growth studies, i.e. number of cycles for unit crack length increase.
- Fatigue of fasteners, i.e. bolts.
- Fatigue of components, i.e. welded joints, gear teeth and small structures.

There are very few materials other than metals which can be tested in EMR machine. The requirement is that the material must behave as a pure undamped spring under the conditions of the test, glass and ceramics would be satisfactory.

- These tests may be carried out while cycling through zero load, or about an entirely tensile or compressive mean load.

- ➢ The test specimen is held vertically in a frame that has its design based on a resonant spring/mass system.
- ➢ The principle of operation is that a cyclic load is produced in a specimen by exerting the natural resonance of a mass supported by a spring, of which the specimen is a part.
- ➢ The model 1603 EMR Machine is basically two contra-oscillating masses with the spring between them.

2.5 Transmission system in EMR Machine

2.5.1 For applying Mean Load

Auto mean load motor (i.e. separately excited DC motor)

↓

Through belt drive motor motion is transferred to worm gears.

↓

Now worm gear turns the Acme screws in up or down direction according to load specification

↓

These screws are directly attached to upper and lower masses (i.e. spring mass system)

↓

Now according to screws motion (i.e. pull or push) the masses attached to specimen grip system go apart or come close accordingly and thus a tensile or compressive mean load applied to specimen.

Here we see that for applying mean load either tensile or compressive an auto mean load motor i.e. a DC separately excited traction motor has been used. First this main motor starts then via a belt drive motor motion is transferred to worm and worm gears system. Now from these worm gears Acme thread drive is turned. Now when these screws turn according to movement of gears and the spring/ mass system which is supported and guided by leaf springs accordingly pulled or pushed and thus a tensile or compressive mean load is automatically maintained. Here we see that the upper mass is attached to its support springs are separated by four Acme screws which pull together or push apart the nodal points of the upper and lower mass springs are to apply a tensile or compressive mean load when rotated by a servo motor through worm gears. Apart from this another mean load applying system is set in centre i.e. mean load adjusting screw which is attached through the upper mass with the help of worm and worm gearing.

2.5.2 For applying Cyclic Load

Electro-Magnet is energized by high current pulses generated at the natural frequency of the spring / mass assembly

↓

The air- gap between the armature attached to lower mass and the magnet is controlled by a servo – driver (motor)

↓

As the air- gap decreases the magnet attracts the armature or repel the armature according to nature of pole developed of armature with respect to magnet.

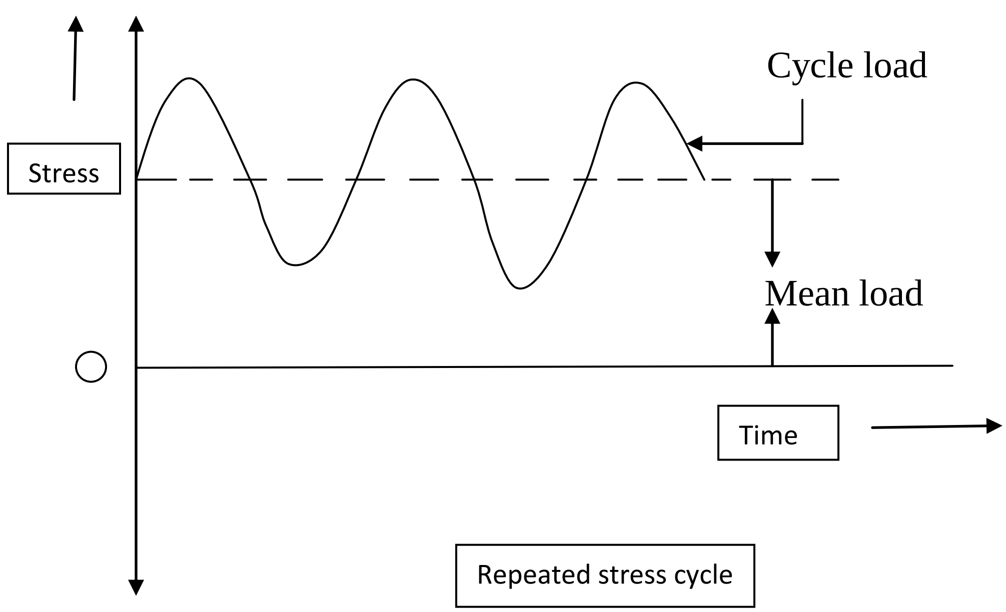
↓

Now for some time magnet attracts and repels respectively to armature and thus oscillation takes place between lower mass attached armature and electro-magnet.

↓

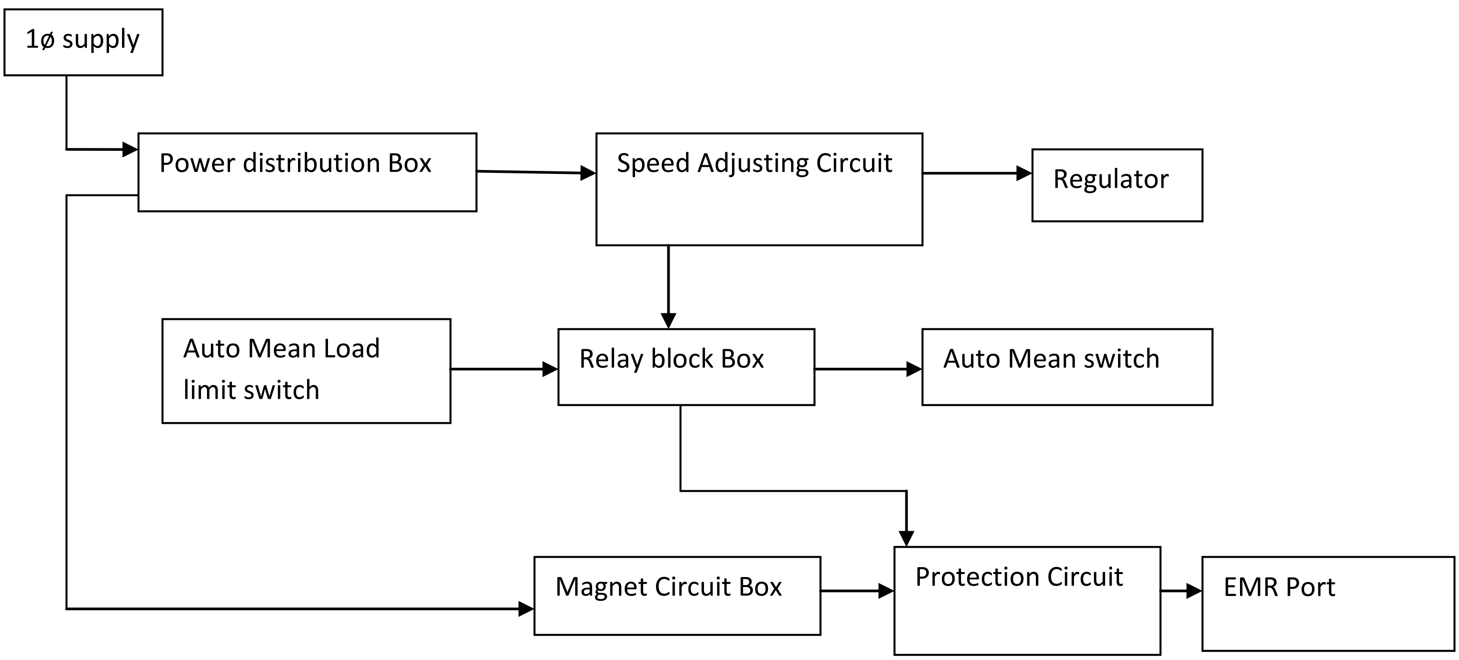
And the frequency of oscillation is as the natural frequency of spring/mass system and thus the cyclic loading is achieved for test specimen.

Here armature is rotated 180^0 in clock wise direction and rest 180^0 in counterclockwise direction by a servo motor which is operated in such a way with the help of power electronics circuit design. And thus in the field of electro –magnet the armature works as south and North Pole respectively and thus electro – magnet repels or attracts the armature. Here electro-magnet pole is fixed. As we know the principle of operation is that apart from mean load a cyclic load is produced in a specimen by exerting the natural resonance of a mass supported by a spring, of which the specimen is a part. Here we see first the air-gap between armatures which is operated by a servo- motor. the motor is controlled by power amplifier and thus the electro-magnet and moving armature (Half cycle in clockwise direction and half of the cycle in counterclockwise direction) attracts or repels (i.e. in half cycle either attracts or repels and rest half cycle vice versa) with the frequency that is equal to the natural frequency of spring/mass system and thus the spring/ mass system oscillate with that specified frequency and thus the specimen attached between upper and lower masses oscillates with that frequency and finally we get the cyclic loading on that specimen kept under testing in RMR machine. And thus by combining the mean load and cyclic loading process we can get the final wave form loading (i.e. Fatigue Loading).



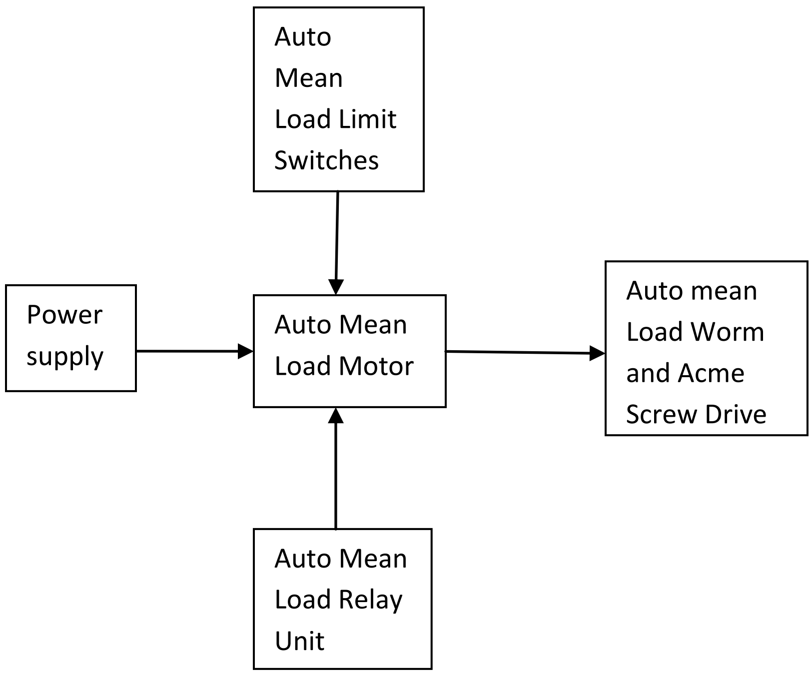
Chapter 3

3.1 Block diagram for running the EMR machine



Here we can see from figure that one phase supply given to power distribution unit from where power distributed to all the machine controlling units such as for application of load either cyclic or mean load. Firstly power goes to relay unit from where it distributed to auto mean switch, auto mean load limit switch then protection circuit via magnet circuit unit and finally the machine port.

3.2 Communication among different parts for Mean Load



Here from block diagram we see that for applying mean tensile load how power transmitted from auto mean load motor to specimen as tensile load.

Firstly Power supply is given to auto-mean load motor and controlled by auto mean load limit switches and auto mean load Relay unit and finally to worm gears which transfers motion to Acme screw thread. Now acme screws impart tensile load that can be controlled and give gradual increment in load up to fracture point.

3.3 Different Electrical parts for successful operation of EMR Machine [1]

3.3.1 Converter

This is converting AC power to DC power which will be supplied to armature and field coils of the DC traction motor. The field is directly connected to the convertor which is getting 195V supply and the armature is connected through relay circuit and the voltage can be varied using Resistance Pot provided in the machine. This can vary the speed of the motor through armature voltage control.

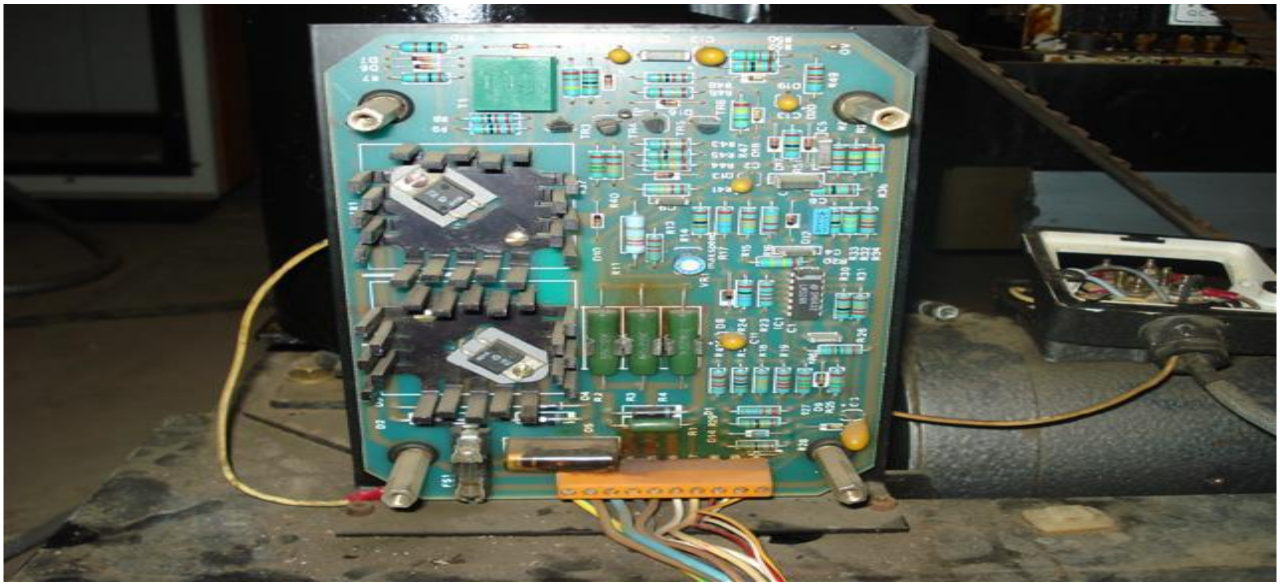


Figure: 4- AC to DC converter

3.3.2 Auto Mean Switch

This switch is used to direct the machine in automatic mode where in the load is applied to the job as preset and the motor adjusts the load cell automatically to get the desired load in the job or the machine can also be operated in manual mode where in the load cell can be moved in desired direction using respective switches provided.

Figure 5: Auto Men switch

Figure 6: Motor switch for AC series Motor

3.3.3 Relay circuit

This basically consists of 2 relays of 15 V, 1A DC which will be used to control upward and downward motion of the lower load cell coupled to the motor with a mechanical arrangement. It is receiving DC power from the converter which has to be fed to the DC Motor armature. The polarity of the supply will decide the direction of rotation of the motor. It receives information from Limit switch and Auto Men Switch and protection circuit. A logic circuit is present to process information from Limit Switch, Auto Men switch and protection circuit. The 15V DC voltage required for relay and electronics devices in logic circuit is received from protection circuit.

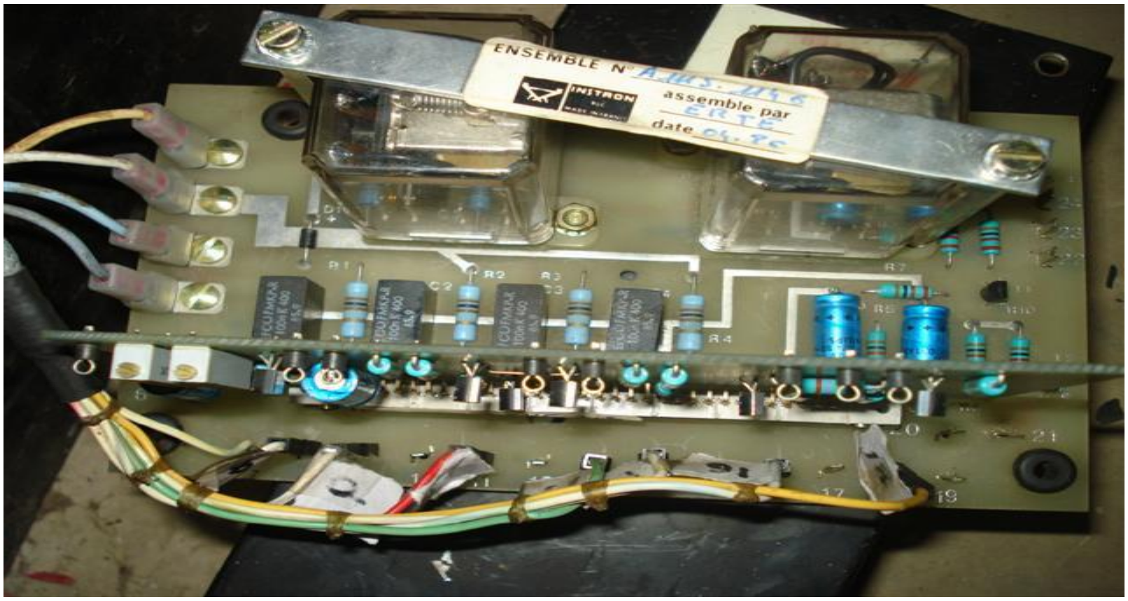


Figure 7: Auto mean load Relay circuit

3.3.4 DC Motor

This is separately exited DC motor manufactured by HELY, France. The rating of the motor is as follows: Power: 245 W, Rotation per min: 3000 T/mn Rated armature voltage: 180V Rated field voltage: 195 V maximum armature current: 1.7A maximum field current: 0.19A.The field is exited from convertor and armature by relay circuit.

3.3.5 Single phase servo motor

This is exited from magnet controller and used for adjusting the air gap in the magnet. The rating of the motor are, Voltage: 220 V, Frequency: 50 Hz, Rotation per min: 1340 T/mn Current: 0.41 A Capacitor rating: 8.2uF, Insulation class: B

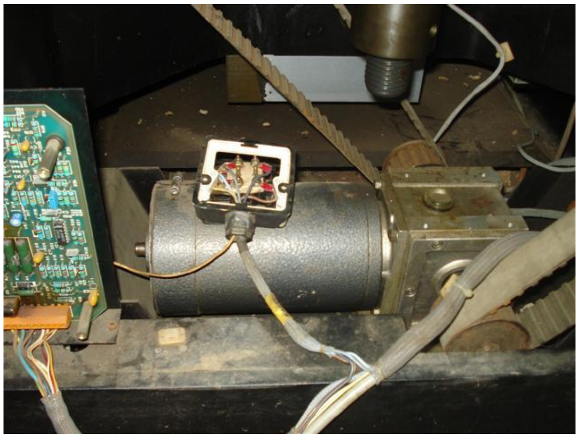


Figure 8: DC Motor

Figure 9: Single phase AC series motor

3.3.6 Protection Circuit

This is communicating with control circuit. The user can set the parameters required for the experiment. Shown in the figure are the various features available that can be configured. The circuit mainly consists of 7 cards.

Figure: 10- Protection Circuit

3.3.7 Control Circuit

The machine can be started and stopped from here. This has various display as shown in the figure which display load, frequency. This machine consists of four logic cards. The +15V and -15V DC source required for the logic circuits and the various other chips in the control circuit, protection circuit, relay circuit and magnet controller is generated here.

Figure: 11- Controller Circuit

3.3.8 Magnet

This is used in the fatigue testing operation. This is basically a electromagnet which is receiving pulses from magnet controller. The rating of electromagnet is yet to be known.

3.3.9 Sensor

There are two sensors mounted on the load cell. One is giving information about load which it gives in terms of voltage ranging from -10V to 10 V, the other sensor is giving the information about the frequency of operation in terms of voltage ranging from 0-5V.

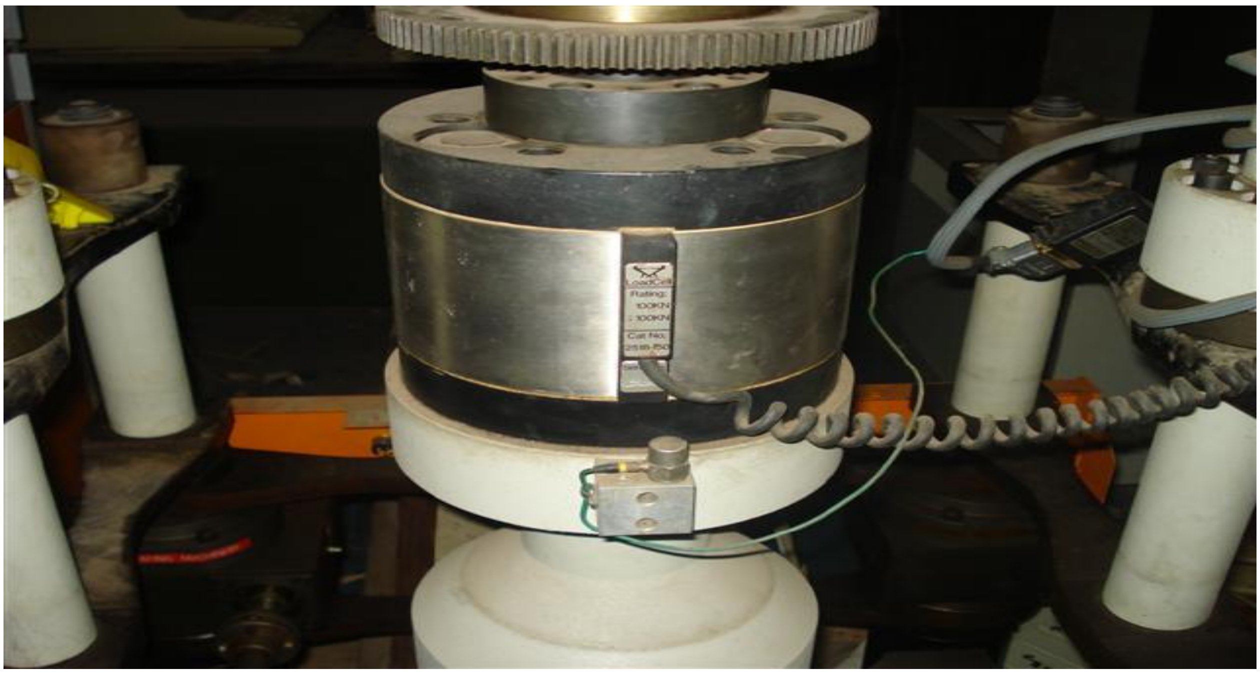


Figure: 12-Sensors mounted on load cell

3.3.10 Magnet controller

The circuit is shown in the figure. This has a power amplifier (T8610) and power diode mounted on heat sink which is supplying electric pulse to the electromagnet.

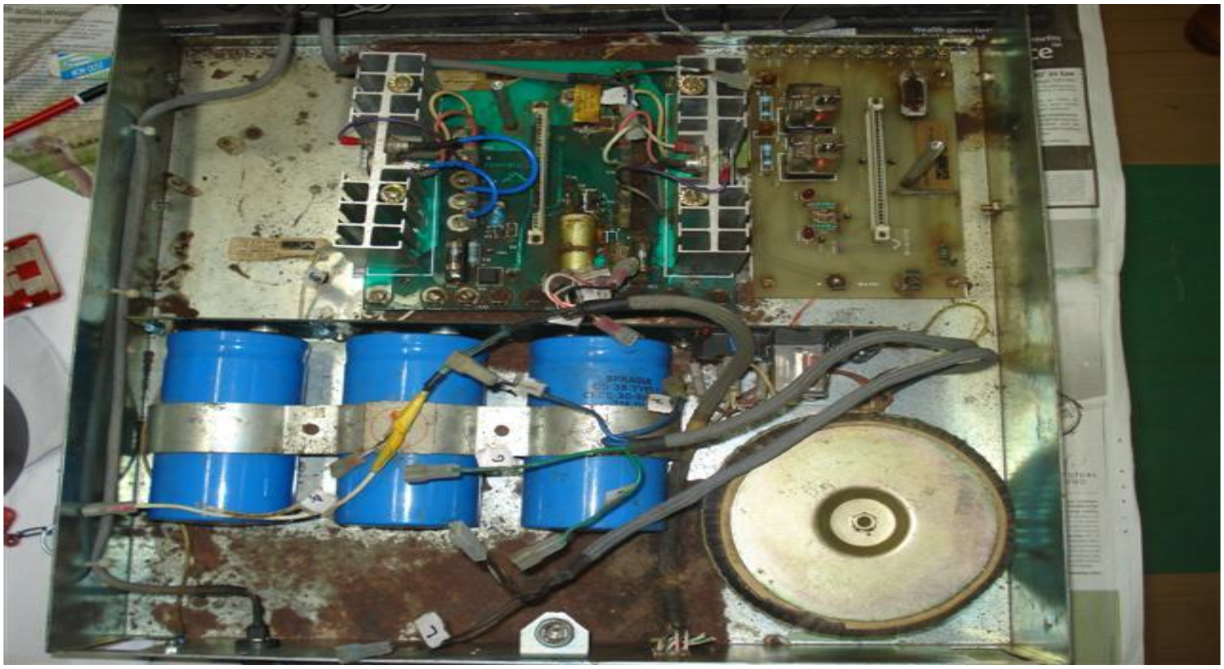


Figure: 13- Magnet controller

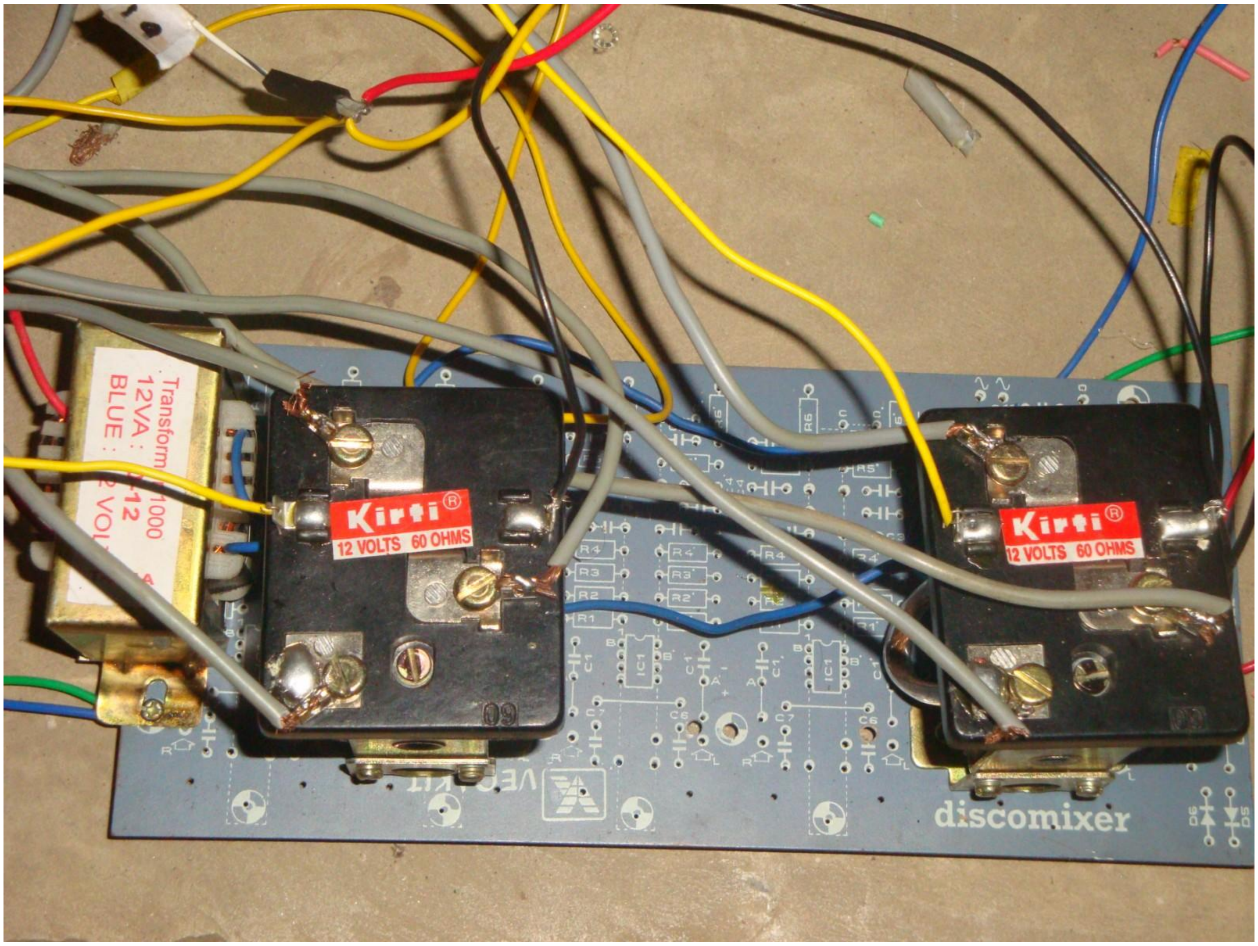


Figure: 14- Newly fabricated Limit Switches

3.3.11 Limit switch

When the machine is given tensile load then a lower displacement limit exist for the load cell below which the machine may get damaged, similarly upper displacement limit exist for compression loading. These limits are been sensed by limit switches and the information is fed to relay circuit to stop the DC motor.

Chapter 4

4.1 Schematic of mechanical transmission system for mean load

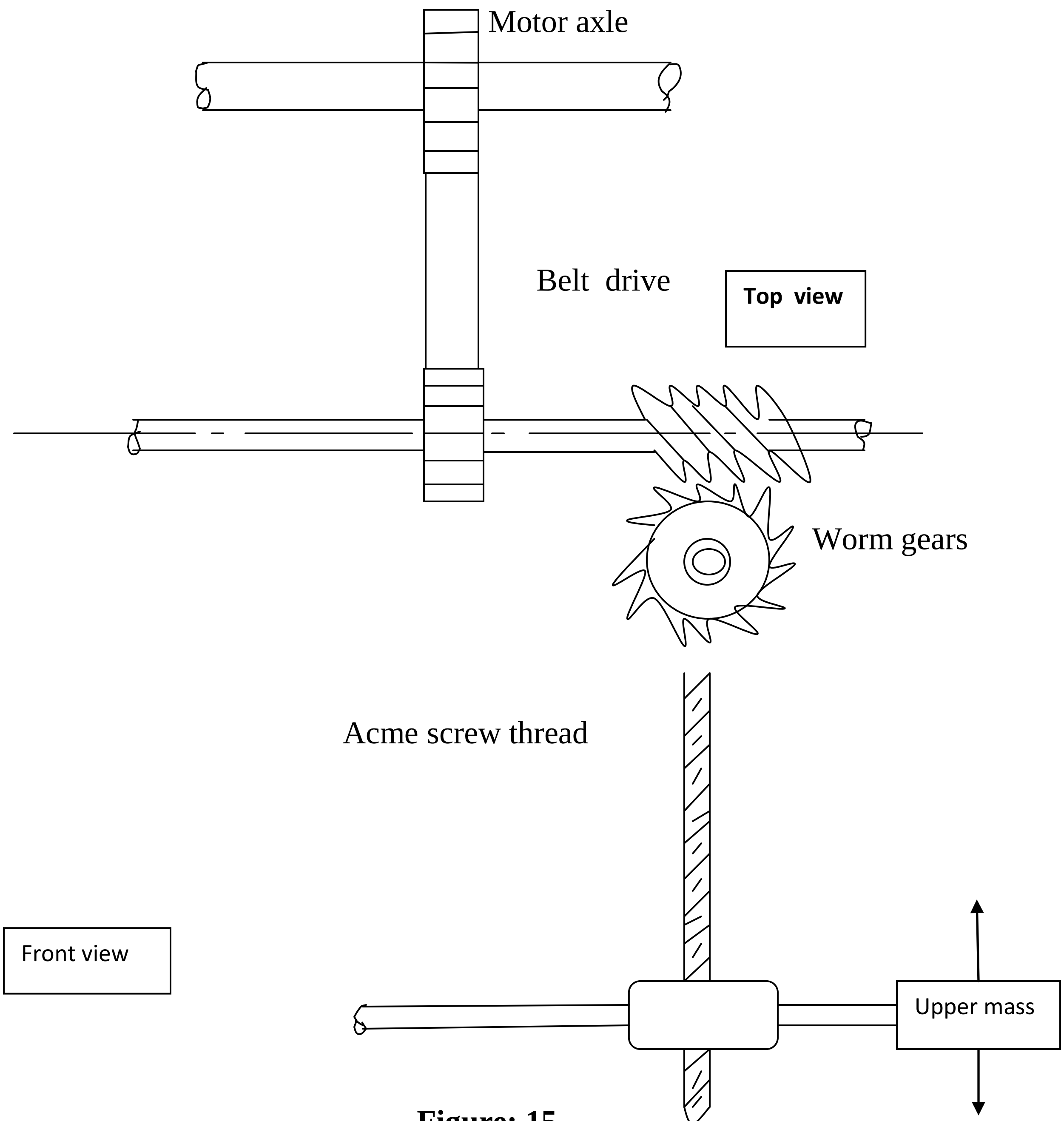


Figure: 15

4.2 Approach for tensile/compressive test

Now here due to lack of time and due to not proper functioning of 1603 controller and protection circuit finally assuming cyclic loading part is not working properly. We are going to use EMR 1603 machine at least for tensile test.

For tensile test we are using Mean load application principle. As we know here mean tensile load is applied due to pull action of Acme screws driven by worm gear. First of all auto mean load motor is started and its motion is controlled by Auto mean load limit switches and Auto mean load Relay Unit. Then motor motion is transferred to worm gears which drive the Acme screws and then they pull the lower and upper mass system apart to each other and in between specimen is fitted which finally stretched and thus tensile load acted upon. Here we see that for applying tensile load (i.e. tensile) an auto mean load motor i.e. a DC separately excited traction motor has been used. First this main motor starts then via a belt drive motor motion is transferred to worm and worm gears system. Now from these worm gears Acme thread drive is turned. Now when which is supported and guided by leaf springs accordingly will be pulled and thus a tensile mean load is automatically maintained. Here we see that the upper mass is attached to its support springs are separated by four Acme screws which will be pulled the nodal points of the upper and lower mass springs are to apply a tensile mean load when rotated by auto mean load motor through worm gears. Apart from this another tensile mean load applying system is set in centre i.e. mean load adjusting screw which is attached through the upper mass with the help of worm and worm gearing. Now our main aim is to apply mean tensile load gradually up to fracture of specimen. For this we will control the motion of auto-mean load motor and we will measure voltage and current corresponding to applied load and then finally the applied tensile load and also the deformation can be measured.

This whole process can be done as following way:

4.3 Transmission system in EMR Machine for Tensile/Compressive load

Auto - mean load motor (i.e. separately excited DC motor)

↓

Through belt drive motor motion is transferred to worm gears.

↓

Now worm gear turns the Acme screws in up or down direction according to load specification

↓

Now according to screws motion (i.e. pull) the masses attached to specimen grip system go apart and thus a tensile mean load applied to specimen.

Chapter 5

5.1 Project outcomes

1. Skills and self confidence was developed in identifying the fault and diagnosing it.

2. The machine working principle was understood.

3. All the electronic circuits were drawn on paper and an effort was made to understand the same.

4. The faults in the circuits mainly relay circuit, Motor used for Daylight arrangement, DC servo motor for Mean load application and Limit switches were identified and fixed.

5. The faulty motors were fixed.

6. The control circuit to operate the machine for tensile and compression testing was designed and fabricated.

7. The machine was made operational (in static mode).

8. The future expectations from this project is that measurement system for load will be developed and I am currently working on this.

9. The literature foundation for this machine is made; this project can be extended as a research project in future to restore the machine for measuring fatigue as well tensile and compression testing.

10. In future the machine can be restored back if some fault occurs because the documentation of the machine would be made keeping the same in mind.

5.2 Suggestions for Future work

5.2.1 Load measuring system

As we have made machine at least comfortable for Tensile and compressive tests due to limited time we could not make any measuring system for Tensile /Compressive Loading parameters as applied Load on specimen and deformation. So we would like to suggest in aspect of load and deformation measuring system of machine to work for Next step as mentioned above.

5.2.2 Calibration of load cell

As we know that Load cell is a transducer that is used to convert a force to Electrical signal. This conversion is indirect and happens in two stages. Through a mechanical arrangement, the force being sensed deforms a strain gauge. The strain gauge converts the deformation (strain) to electrical signals. A load cell usually consists of four strain gauges in a Wheatstone bridge configuration. Load cells of one or two Strain gauges are also available. The electrical signal output is typically in the order of a few milli volts and requires amplification by an instrumentation amplifier before it can be used. The output of the transducer is plugged into an algorithm to calculate the force applied to the transducer [2].

So here we concerning for calibration of Load Cell , this is based on the construction of a linear regression Model for Load cell Data that relates a known Load applied to a Load cell to the deflection of the cell. The model is then used to calibrate future cell readings associated with loads of unknown magnitude [3]. In this process of calibration, The data collected in the calibration experiment consisted of a known load, applied to the load cell, and the corresponding deflection of the cell from its nominal position and finally for a specified range of loads we collect the Data and sketch the graph which provides a good description of the relationship between the load applied to the cell and its response [4].

5.2.3 Fatigue test (dynamic mode)

As we know that Fatigue testing machines apply cyclic loads to test specimens. Fatigue testing is a dynamic testing mode and can be used to simulate how a component/material will behave/fail under real life loading/stress conditions. They can incorporate tensile, compressive, bending and/or torsion stresses and are often applied to springs, suspension components [5]. Here this machine also can be made comfortable for Fatigue Test only if the gap servo start to work properly and a systematic measuring and result display system is found out.

References

[1] Operation Manual, EMR 1603 Material Testing Machine

[2] http://en.wikipedia.org/wiki/Load_cell

[3] http://itl.nist.gov/div898/handbook/pmd/section6/pmd61.htm

[4] http://itl.nist.gov/div898/handbook/pmd/section6/pmd611.htm

[5] http://www.azom.com/equipment.asp?cat=47